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DEPARTMENT OF THE ARMY, TULSA DISTRICT  
U.S. ARMY CORPS OF ENGINEERS  
CEGS-02200  
DEC 96

TULSA DISTRICT GUIDE SPECIFICATION

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SECTION 02200

EARTHWORK (MINOR REQUIREMENTS)

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NOTE: This section covers earthwork for buildings, roadways and parking areas, utility trenches, and grading. It may be used for projects where all of the above is generally of a minor nature, for instance building projects with less than 5000 SF ground floor area with parking area and service line type utilities. This section will replace sections 02110, 02210, 02221, 02222, & 02225.

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1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

|             |   |
|-------------|---|
| ASTM C 33   | (1993) Concrete Aggregates  |
| ASTM C 136  | (1995a) Sieve Analysis of Fine and Coarse Aggregates  |
| ASTM D 422  | (1963; R 1990) Particle-Size Analysis of Soils  |
| ASTM D 1556 | (1990) Density of Soil In-Place by the Sand-Cone Method   |
| ASTM D 1557 | (1991) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Lb. (4.54-kg) Rammer and 18-In. (457-mm) Drop |
| ASTM D 2216 | (1992) Laboratory Determination of Water (Moisture) Content of Soil, and Rock   |
| ASTM D 2487 | (1993) Classification of Soils for Engineering Purposes   |
| ASTM D 2922 | (1991) Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)   |
| ASTM D 4253 | (1993) Maximum Index Density and Unit Weight of Soils Using a Vibratory Table   |

## 1.2 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D 1557 or ASTM D 4253. ASTM D 1557 shall be used for soils containing 15 percent or more passing the no. 200 sieve (fines). ASTM D 4253 shall be used for soils containing 5 percent or less fines. The maximum laboratory dry density for soils containing between 5 and 15 percent fines shall be determined by the above procedure yielding the highest laboratory dry density. The percentage of material passing the no. 200 sieve shall be determined in accordance with ASTM D 422. Degree of compaction shall be expressed as a percentage of the maximum laboratory dry density obtained by the appropriate procedure as defined above. Percentage of maximum laboratory dry density has been abbreviated hereinafter as percent laboratory maximum density.

## 2 PRODUCTS

### 2.1 MATERIALS:

#### 2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified in ASTM D 2487, as GW, GP, GC, GM, SW, SP, SM, SC, CL, and CH.

#### 2.1.2 Unsatisfactory Materials

Unsatisfactory materials shall comprise any materials classified in ASTM D 2487, as PT, OH, OL, ML and MH.

#### 2.1.3 Cohesionless and Cohesive Materials

Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Cohesionless materials include materials classified in ASTM D 2487, as GW, GP, SW, and SP. Materials classified as GM and SM are identified as cohesionless only when the fines have a plasticity index of zero. Additional particle size analysis shall be made as necessary using ASTM C 136 or ASTM D 422 as applicable.

#### 2.1.4 Nonexpansive Fill

Nonexpansive fill shall be satisfactory material, except CL and CH material, having a plasticity index less than or equal to 12.

#### 2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches 75 mm in any dimension.

#### 2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenance structure.

### 2.1.7 Granular Material

Granular materials shall be sand, crushed stone, crushed gravel, or pea gravel conforming to the requirements of **ASTM C 33**, gradation size 67 as follows:

| <u>Sieve Size</u> | <u>Percent Passing</u> |
|-------------------|------------------------|
| 1"                | 100                    |
| 3/4"              | 90 to 100              |
| 3/8"              | 20 to 55               |
| No. 4             | 0 to 10                |
| No. 200           | 0 to 5                 |
| 25 mm             | 100                    |
| 19 mm             | 90 to 100              |
| 9.25 mm           | 20 to 55               |
| No. 4             | 0 to 10                |
| No. 200           | 0 to 5                 |

### 2.1.8 Select Backfill Material

Select backfill material for trench backfill shall consist of satisfactory material free from stones larger than **2 inches 50 mm** in any dimension except that where the pipe is coated or wrapped for protection against corrosion, the backfill material shall be free of stones larger than **1 inch 25 mm** in any dimension.

### 2.1.9 Capillary Water Barrier

Capillary water barrier under concrete floor slabs on grade shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be **1-1/2 inches 38 mm** and no more than 2 percent by weight shall pass the No. 4 sieve size.

### 2.1.10 Plastic Marking Tape

Plastic marking tape shall be acid and alkali- resistant polyethylene film, **6 inches 150 mm** wide with minimum thickness of **0.004 inch 4 mils**. Tape shall have a minimum strength of **1750 psi 12.1 Mpa** lengthwise and **1500 psi 10.2 Mpa** crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to **3 feet 1 meter** deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified below and shall bear a continuous printed inscription describing the specific utility:

#### TAPE COLOR

|        |  |
|--------|--|
| Red    | Electric   |
| Yellow | Gas, Oil, Dangerous Materials                                    |
| Orange | Telephone, Telegraph, Television, Police and Fire Communications |
| Blue   | Water Systems  |
| Green  | Sewer Systems  |

## 2.2 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

## 3 EXECUTION

### 3.1 CLEARING AND GRUBBING

[Clearing and grubbing shall conform to Section 02110 CLEARING AND GRUBBING.] [The areas within lines 5 feet 1.5 meters outside of each building and structure line shall be cleared and grubbed of trees, stumps, roots, brush, and other vegetation, debris, existing foundations, pavements, utility lines, structures, fences, and other items that would interfere with construction operations. Stumps, logs, roots, and other organic matter shall be completely removed and the resulting depressions shall be filled with satisfactory material placed and compacted in accordance with paragraph "Filling and Backfilling." Materials removed shall be disposed of [in the designated waste disposal areas] [outside the limits of Government controlled property at the Contractor's responsibility].]

### 3.2 STRIPPING AND CONSERVATION AND REPLACEMENT OF TOPSOIL

Topsoil shall be defined as natural, friable surface soil possessing the characteristics of representative soils in the vicinity that produce heavy growth of crops, grass, or other vegetation. Topsoil in cut or fill areas shall be stripped and spread on areas already graded and prepared for topsoil, or when so directed, topsoil shall be transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be stripped to a minimum depth of 6 inches and, when stored, shall be kept separate from other excavated materials and stockpiled free of roots, stones, and other undesirable materials. [Upon completion of excavation or fill, topsoil or stripping conserved shall be uniformly distributed over all disturbed areas.] [Topsoil shall be distributed uniformly and spread to a minimum thickness as shown on the drawings.] Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, excessively compacted, or in a condition detrimental to the proposed planting or grading. Soil compacted by construction equipment or soil on compacted cut slopes or grades shall be scarified to a minimum depth of 4 inches 100 mm by disking or plowing before applying topsoil.

After each layer of topsoil has been spread, the entire surface shall be compacted by not less than one complete pass of a crawler tractor or other approved means. A complete pass shall be defined as one coverage of the entire surface of the lift by the track surface.

### 3.3 BLASTING

Blasting [will] [will not] be permitted. [The Contractor shall submit a Blasting Plan and obtain written approval prior to performing any blasting. The plans shall contain provisions for storing, handling and transporting explosives as well as for the blasting operations. The Contractor shall be responsible for damage caused by blasting operations.]

### 3.4 EXCAVATION

After all stripping has been completed, excavation of every description, regardless of material encountered, shall be performed to the lines and grades indicated. Satisfactory excavation material shall be transported to

and placed in fill areas within limits of the work. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material. Payment therefor will be made in conformance with the contract clause entitled "Changes". Satisfactory material removed below the depths indicated without specific direction of the Contracting Officer shall be replaced at no additional cost to the Government, to the indicated excavation grade with satisfactory materials, except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations and overbreak in rock excavation. Provide proper drainage at all times.

#### 3.4.1 Drainage

Excavation shall be performed so that the area of the site and the area immediately surrounding the site and affecting operations at the site will be continually and effectively drained. Water shall not be permitted to accumulate in excavations. The excavation shall be drained by pumping or other satisfactory methods to prevent softening of subgrades or foundations.

#### 3.4.2 Ditches

Excavation of ditches shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Care shall be taken not to excavate ditches below grades shown. Excessive open ditch excavation shall be backfilled with satisfactory, thoroughly compacted material to grades shown at no additional cost to the Government. The Contractor shall maintain all excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

#### 3.4.3 Drainage Structures

Excavations shall be made accurately to the lines, grade, and elevations shown or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown.

#### 3.4.4 Shoring

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving. In lieu of shoring, banks may be cut to backslopes in accordance with the Corps of Engineers Safety Manual.

#### 3.4.5 Final Grade of Surfaces to Support Concrete

Excavation to final grade shall not be made until just before concrete is to be placed. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut into rough steps or benches to provide a satisfactory bond. Subgraded surfaces for concrete boxes may be overexcavated provided the backfill consists of crushed rock, gravel, sand, or lean concrete fill leveled to provide a working surface for the structure slab. Shales shall be protected from slaking or other erosion resulting from ponding or flow of water.

#### 3.4.6 Trench Excavation

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below and above the top of the pipe shall be sloped, or made vertical, as recommended in the manufacturer's installation manual. The trench width below the top of the pipe shall not exceed that recommended in the installation manual. Where no manufacturer's installation manuals are available, trench walls below the top of the pipe shall be vertical, and trench walls above the top of the pipe shall be sloped as required to properly complete the work. Trench width below the top of the pipe shall not exceed 24 inches 600 mm plus pipe outside diameter (O.D.) for pipes of less than 24 inches 600 mm inside diameter, and shall not exceed 36 inches 900 mm plus pipe O.D. for larger sizes.

##### 3.4.6.1 Bottom Preparation

When pipe is laid directly on trench bottom, the bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size of each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

##### 3.4.6.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 4 inches below the required grade and replaced with suitable materials.

##### 3.4.6.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with granular material specified hereinbefore. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

##### 3.4.6.4 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly tamped in such sections. Plans shall be submitted for approval indicating the proposed method and materials.

#### 3.5 UTILIZATION OF EXCAVATED MATERIALS

All unsatisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas [or outside the limits of Government controlled land at the Contractors expense.] Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, subgrades, shoulders, and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be [disposed of in designated areas approved for surplus material storage or designated waste areas as directed], or [uniformly spread in the graded area] or [spread to uniformly widen embankment side slopes].

### 3.6 BORROW MATERIAL

Where satisfactory materials are not available in sufficient quantity from required excavations, borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas shown or from other approved sources, either private or within the limits of the project site. The Contractor shall obtain from the owners, the right to procure material, pay all royalties and other charges involved, and bear all expense of developing the sources, including rights-of-way for hauling. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation and shall be performed by the Contractor at no additional cost to the Government.

### 3.7 BACKFILL ADJACENT TO STRUCTURES

Backfill adjacent to structures shall be placed and compacted uniformly in such manner as to prevent wedging action or eccentric loading upon or against the structures. Slopes bounding or within areas to be backfilled shall be stepped or serrated to prevent sliding of the fill. During backfilling operations and in the formation of fills, equipment that will overload the structure in passing over and compacting these fills shall not be used. Backfill for storm drains and subdrains, including the bedding and backfill for structures other than culverts and drains, shall conform to the additional requirements in other applicable sections.

### 3.8 PREPARATION OF GROUND SURFACE FOR FILL

Vegetation, such as roots, brush, heavy sods, heavy growth of grass, and all decayed vegetable matter, rubbish and other unsatisfactory material within the area upon which fill is to be placed shall be stripped or otherwise removed before the fill is started. In no case shall unsatisfactory material remain in or under the fill area. Sloped ground surfaces steeper than 1 vertical to 4 horizontal on which fill is to be placed shall be plowed, stepped or benched, or broken, up, as directed, in such manner that the fill material will bond with the existing surface. Prepared surfaces on which compacted fill is to be placed shall be scarified wetted, or dried, as may be required to obtain the compaction specified.

### 3.9 CAPILLARY WATER BARRIER

The capillary water barrier shall be placed directly on the subgrade beneath the concrete floor slabs on grade and shall be compacted with minimum of two passes of a hand-operated plate-type vibratory compactor.

### 3.10 FILLING AND SUBGRADE PREPARATION

Satisfactory materials free from roots and debris shall be used in bringing fills to the lines and grades indicated and for replacing unsatisfactory materials. Nonexpansive soils shall be used in nonexpansive fill under building slabs. Where nonexpansive fill is indicated under floor slabs all fill under such slabs shall be nonexpansive fill. Where no fill is required or where the fill under the capillary water barrier is less than 18 inches 450 mm in depth, the subgrade shall be excavated and replaced with nonexpansive fill to a minimum depth of 18 inches 450 mm beneath the capillary water barrier. The subgrade below the nonexpansive fill shall be loosened to a depth of 6 inches 150 mm, moistened, manipulated and

recompacted as specified hereinafter. The moisture content of both the nonexpansive fill and subgrade material after compaction shall be equal to or greater than optimum moisture content. When the subgrade under buildings is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches 300 mm and compacted as specified for the adjacent fill. Satisfactory material shall be placed in horizontal loose depth layers not exceeding 8 inches for fill under buildings and structures, 6 inches 150 mm under road or parking areas, and 8 to 12 inches 200 to 300 mm for all other areas and then compacted. Material shall not be placed on surfaces that are muddy, frozen, or contain frost.

### 3.11 PAVEMENT SUBGRADE PREPARATION

Pavement subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 6 inches below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. The elevation of the finished subgrade shall not vary more than 0.05 foot 15 mm from the established grade and cross section.

### 3.12 TRENCH BACKFILL

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 2 feet above the top of pipe or to top of grade surface prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

#### 3.12.1 Bedding and Select Backfill:

##### 3.12.1.1 General

Bedding material shall consist of granular material specified hereinbefore or material recommended by the pipe manufacturer. Select backfill shall be material specified hereinbefore or as recommended by the pipe manufacturer. Bedding and select backfill material shall be placed in layers of a maximum of 6 inches 150 mm loose thickness and compacted with approved tampers. The backfill shall be brought up evenly on both sides of pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

##### 3.12.1.2 Class B (First Class) bedding

All flexible pipe as defined below shall be placed in Class B bedding. Class B shall consist of a bedding material from the trench bottom to one foot over the top of the pipe and a minimum of 4 inches 100 mm under the pipe.

##### 3.12.1.3 Class C (Ordinary) bedding

All cast iron, ductile iron or vitrified clay pipe greater than 3 inches 75 mm in diameter shall be placed in Class C bedding. Class C bedding shall consist of bedding material from the trench bottom up to a distance equal to 1/6 times the outside diameter of the pipe above the pipe bottom and a

minimum of 4 inches 100 mm under the pipe. Select backfill material shall then be placed to a minimum of one foot above the top of the pipe.

#### 3.12.1.4 Select material backfill

All pipe not placed in bedding shall be placed with select backfill from the trench bottom to a minimum of one foot above the top of the pipe. Where trench bottom is rock, select backfill material shall also be placed to a minimum depth of 4 inches 100 mm beneath pipe.

#### 3.12.2 Final Backfill

The remainder of the trench above the bedding or select backfill except for special materials for paved areas shall be backfilled with satisfactory material. Backfill material shall be deposited as follows and compacted as specified in paragraph "Compaction".

##### 3.12.2.1 Traffic Areas

Backfill shall be placed in accordance with paragraph: Filling and Subgrade Preparation. Water flooding or jetting methods of compaction will not be permitted.

##### 3.12.2.2 All Other Areas

Backfill shall be deposited in layers of a maximum of 12-inch 300 mm loose thickness, and compacted. [Water flooding or jetting methods of compaction will be permitted for granular on-cohesive backfill material. Water jetting shall not be allowed to penetrate the initial backfill.] [Compaction by water flooding or jetting will not be permitted.] This requirement shall also apply to all other areas not specifically designated above.

#### 3.12.3 Flexible Pipe

The following types of pipe shall be considered flexible pipe for purposes of backfill requirements.

Polypropylene  
ABS  
PVC  
Polybutylene

Polyethylene  
Reinforced Thermosetting Resin (RTRP)  
Reinforced Plastic Mortar (RPMP)

### 3.13 SPECIAL TRENCHING REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utility trenching are as follows:

#### 3.13.1 Gas Distribution

Trenches shall be excavated to a depth that will provide not less than 18 inches 450 mm of cover in rock excavation and not less than 24 inches 600 mm of cover in other excavation. Trenches shall be graded as specified for pipelaying requirements in Section 02685 GAS-DISTRIBUTION SYSTEM.

#### 3.13.2 Waterlines

Trenches shall be of a depth to provide a minimum cover of 2-1/2 feet 750 mm from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

### 3.13.3 Heat Distribution System

Initial backfill material shall be free of stones larger than 1/4 inch 8 mm in any dimension.

### 3.13.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise indicated. [Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND].

### 3.13.5 Plastic Marking Tape

Marking tapes shall be installed in the trench directly above the utility at a depth of [6] [12] [18] inches [150] [300] [450] mm below finished grade.

## 3.14 COMPACTION

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Unless otherwise specified, material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Using the appropriate laboratory maximum dry density test procedure as defined in Part 1 above, each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

|  | Percent Laboratory<br>Maximum Density |             |
|--|---------------------------------------|-------------|
|  | ASTM D 4253                           | ASTM D 1557 |
| <u>Fill, embankment, and backfill</u>  |                                       |             |
| Under proposed structures, building slabs, steps, and paved areas except nonexpansive fill | 95                                    | 95          |
| Under sidewalks and grassed areas  | 90                                    | 90          |
| Nonexpansive fill  | 92                                    | 95          |
| <u>Subgrade</u>  |                                       |             |
| Under building slabs, steps, and paved areas, top 12 inches 300 mm                         | 90                                    | 90          |
| Under sidewalks, top 6 inches 150 mm   | 85                                    | 90          |

## 3.15 FINISHING

The surface of all excavations, fills, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for all graded areas shall be within 0.1 foot 30 mm of the grades and elevations indicated except as otherwise specified for roadway subgrades. Ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be

turfed shall be finished to a smoothness suitable for the application of turfing materials.

### 3.16 SUBGRADE AND FILL PROTECTION

During construction, fills, and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained in such a manner as to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operations and shall be protected and maintained by the Contractor in a satisfactory condition until base course or pavement is placed. The storage or stockpiling of materials on the finished subgrades will not be permitted. No base course or pavement shall be laid until the subgrade has been checked and approved, and in no case shall base, surfacing, or pavement, be placed on a muddy, spongy, or frozen subgrade.

### 3.17 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. Moisture contents shall be determined in accordance with [ASTM D 4643](#) and/or [ASTM D 2216](#). If the [ASTM D 4643](#) procedure is used, moisture contents shall be checked by the ASTM D 2216 procedure once per each 10 ASTM D 4643 tests. Field in-place density shall be determined in accordance with [ASTM D 1556](#) or [ASTM D 2922](#). If [ASTM D 2922](#) is used, in-place densities shall be checked by the [ASTM D 1556](#) procedure at a frequency on one sand cone test for each 8 nuclear density tests and not less than one sand cone density test per lift. The sand cone test shall be performed adjacent to the location where a nuclear density test was performed to insure a proper correlation is established between the two density test procedures. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements, at no additional expense to the Government. Tests on recompacted areas shall be performed to determine conformance with specification requirements. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type operation.

#### 3.16.1 Moisture Content

Moisture contents shall be determined on materials obtained from each density sample location.

#### 3.16.2 Field In-Place Density Tests:

##### 3.16.2.1 Buildings

One test per 1000 square feet 100 square meters (building 5000 sq. ft. 450 sq. m. or less), 2500 square feet 230 square meters (buildings 5,000 to 20,000 sq. ft. 450 to 1850 sq. m.) 5000 square feet 450 square meters (buildings over 20,000 sq. ft. 1850 sq. m.) per lift of subgrades or fills beneath buildings but not less than one test per lift

#### 3.16.2.2 Paved Areas

One test per 2000 square yards 1675 sq. meters per lift of compacted material or fraction thereof.

#### 3.16.2.3 Sidewalks

One test per 600 square 1850 sq. m. feet of walkway surface or fraction thereof.

#### 3.16.2.4 Turfed Areas

One test per 2500 cubic yards 1900 cubic meters of compacted material, or fraction thereof.

#### 3.16.2.5 Trenching

One test per 100 linear feet 30 linear meters of trench per lift in paved areas and one test per 300 linear feet 90 linear meters of trench per lift in all other areas.

#### 3.16.3 Optimum Moisture and Laboratory Maximum Dry Density

The laboratory maximum dry density shall be determined from materials obtained at a sand cone test location using the appropriated procedure specified in Part 1 above. When ASTM D 1557 is used, the optimum moisture content shall be determined. A minimum of one laboratory maximum dry density test shall be run each placement day or fraction thereof. Additional laboratory maximum dry density tests shall be run for each material change.

#### 3.17 DISPLACEMENT OF SEWERS

After other required tests have been performed and the trench backfill compacted to 2 feet 600 mm above the top of the pipe or to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 36 inches 900 mm shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied.

#### 3.18 GRADING

Areas within 15 feet 5 meters outside of each building line shall be graded to provide positive drainage away from the building.

Where a building perimeter is not covered by pavement, a layer of impervious fill 18 inches 450 mm thick shall extend for 15 feet 5 meters from the building. Impervious fill is defined as satisfactory material that is classified as CL or CH, has a liquid limit greater than or equal to 25, and has greater than 60 percent by dry weight passing the No. 200 sieve.

--End of Section--